




Title of Slide Presentation



Tools and Technology for Accessible Trails

Peter Axelson
Jeremy Vlcan

Beneficial Designs, Inc.
Minden, Nevada


Arroya Sit Ski



Hand Bike




Mono Ski



Dynamic Seating Spring Assist

Cross Country Ski




Title of Slide Presentation

Pax Back



Available from
BES Rehab Ltd

Aircraft Aisle Chair



Dynamic Seating



HipGrip

The HipGrip is a postural seating device designed to help control pelvic position and provide stability while in a wheelchair while allowing range of motion and movement in anterior and posterior pelvic tilt.

Available from
Bodypoint



FlexRim



GripRim



Title of Slide Presentation



Adaptive Canoe Seating



Available from
**Chosen Valley
Canoe Accessories**

What makes a great trail?

- Providing trail access information
- Preventing access barriers
- Improving trail surfaces
- Protecting the environment



“Moderate” or “Easy”
mean different things
People have different
abilities (young children,
older adults, people with disabilities, unfit and
inexperienced individuals)
Assessment must provide objective
information

Assessment and Compliance

- Inventory existing facilities and
infrastructure
- Determine compliance with existing
ADAAG and Developed Outdoor
Recreation facilities
- Create transition plan with goals and
objectives for accomplishing access

Universal Trail Assessment Process



Title of Slide Presentation



Key UTAP Information

Length



Grade



Width



Surface



Cross
slope



Features &
Facilities



UTAP Assessment Team



UTAP – Implementation Status

Over 1000 people trained to lead UTAP assessments

Over 55 trainers to teach UTAP workshops

State and agency-wide implementation is growing (AZ, MN, IN, NY, CA, FL)

UTAP assessments available from consultants

Development of a Complete Outdoor Recreation Assessment Process

Develop and validate a repeatable assessment process for all Outdoor Recreation Elements

Create instructions and data collection forms to determine compliance

Set up electronic data collection and data base for management of information

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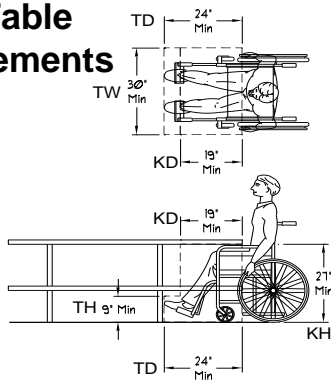
DORAP Deliverables

- Data collection forms with instructions
- Software to record and export data
- Tool kit for performing all measurements
- One day training course on DORAP
- Web based DORAP training course
- Combine with UTAP for comprehensive training

DORAP applies too

- Urban or rural trails of any type
- City, county and state parks
- Picnic and camping facilities
- Visitor centers and rest areas
- Any public area that has any Outdoor Recreation Elements

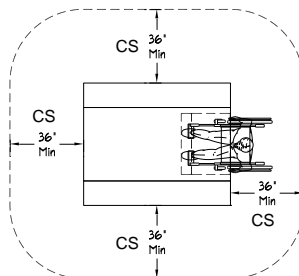
Picnic Table Measurements



Measurement Comparisons

Name	Premm iter Feet	Spaces Req'd	Total Width Inches	Knee Depth Inches	Knee Height Inches	Toe Depth Inches	Toe Height Inches
Minimum		1	30	19	27	24	9
P.K.	~	1	37	8	27.5	8	27.5
K.N.	~	1	28	9	27	9	27
J.V.	16.8	1	36	8	28	8	28
B.B.	16.4	1	37	7.5	27	7.5	27
J.S.	14	1	37	8	27	8	27
S.P.	16.6	1	37	8	27	8	27

Picnic Table Clearance



Measurement of Surface Firmness and Stability

- Rotational penetrometer developed to objectively measure surfaces
- Portable device that can be used in the field
- Allows measurement of carpets, playgrounds and trail surfaces

Title of Slide Presentation

TrailWare
Feature Data Entry

Required feature data omitted

Help Exit TW

Park List | Park Info | Trail List | Trail Detail | Segments | Segment Cover | Stations | Features | Reports

Trail Name: Pioneer Segment Name: 1 Sag Pioneer to Mill Date: Apr 22, 2002 Recorder: Add Feature

Feature Distance	TV Zone	Feature Type	Feature Description	Size L x W x H	UM	Count/Qty	End Distance	Remain Feature Tread	Action Required	Materials	Photo	Finish Entry
0	T	Trailhead	Parking Lot									
0	V	Restroom	Chemical Toilet			1			Yes			
47	V	Picnic Table	Wooden			2						
53	V	Scenic Viewpoint	Int. Cora			149						
69	T	Route	Multiple Routes	14	5	6	in	5	83	30		
130	V	Bench	Back and armrests	60	18	18	in	1				
199	T	Rock	Small Boulder	13	12	18	in	1	48	Remove		
239	V	Bench	Back and armrests	60	18	18	in	1				
334	T	Waterbar	4 X 4 Plank	4	54	8	in	1	0			
338	T	Erosion	Center of Trail	10	8	12	in		Monitor			
416	T	Minimum Clearance	Boulder large, centered in path	40	22	20	in		Remove			
621	V	Bench	Back only	60	18	18	in	1				

Blue shading: Fields exported to Trail Explorer or used in Trail Explorer calculations
Yellow shading: Calculated fields, also used in Trail Explorer
Red buttons: Warning - required station data is missing

TrailWare Reports

English or Metric units

Data summaries:

Grade, Cross Slope and Width
Surface Category and Type
Tread and Vertical Obstructions

Trail Access Information

Station or Feature Log Report

Pioneer Morgan Grist Mill

Feature Log (to sort by column, click on underlined headings)

Print (with Notes) Print (no Notes) Export Reports

Feature Distance	TV Zone	Feature Type	Feature Description	Size L x W x H	UM	Count/Qty	End Distance	Remain Feature Tread	Action Required	Materials	Photo
1	334	T	Waterbar	4 X 4 Plank	4	54	8	in	0		
1	291	T	Waterbar		4	50	8	in	1	0	
1	2077	V	Water	Drinking Fountain		2			Yes		
1	1486	T	Vertical	Branches	36	60	48	in	1801	0	Remove
2	1483	T	Vertical	Branches	40	48	8	in	1487	0	Clear
2	1487	T	Vertical	Overhanging Rock	67	40	73	in	1483	20	
1	1475	V	Trees	Old Hickory Grove					1008		
2	226	V	Trees	Oak Tree Grove					283		

Summary Tables for Typicals

Pioneer Morgan Grist Mill

Grade Percentages

first segment assessed Apr 22, 2002
last segment assessed Apr 22, 2002

Grade %	% of trail	Length m	km	Sum % of trail
0-3	63.9%	765.0	0.77	>=0 100.0%
3.1-5	25.1%	300.8	0.30	>3 36.1%
5.1-8	7.0%	83.5	0.08	>5 11.0%
8.1-10	0.9%	11.3	0.01	>8 4.0%
10.1-12	0.9%	10.4	0.01	>10 3.1%
12.1-14	0.7%	8.8	0.01	>12 2.2%
14.1-16	0.7%	8.2	0.01	>14 1.5%
16.1-20	0.8%	9.1	0.01	>16 0.8%
20.1-30	0.0%	0.0	0.00	>20 0.0%
30.1-50	0.0%	0.0	0.00	>30 0.0%
over 50	0.0%	0.0	0.00	>50 0.0%
Total	100.0%	1197.2	1.20	

Extreme Summary Tables

Pioneer Morgan Grist Mill

Maximum Grade Percentages

First Segment Assessed Apr 22, 02
Last Segment Assessed May 7, 02

Grade %	Length ft	Location ft mi	Cumulative Length (ft) and Grade
19.4 %	8.00	2264.0	0.43
19.6 %	5.00	2307.0	0.44
19.6 %	7.00	3127.0	0.59
19.3 %	10.00	3658.0	0.69
15.4 %	6.00	2350.0	0.46
15.3 %	6.00	3346.0	0.63
14.1 %	15.00	433.0	0.08
13.2 %	11.00	517.0	0.10
			68.0 >= 13.2 %

TrailWare Calculations

Typical and extreme values for
Grade, Cross Slope and Width
Surface Category and Type
Tread and Vertical Obstructions

Title of Slide Presentation

Development Support

Universal Trail Assessment Process
 Rotational Penetrometer and
 Trailware, trail data processing software
 All supported with funding from the NIH
 NICHD National Center for Medical
 Rehabilitation Research SBIR Program

Wheeled Instrumentation Sensor Package - WISP

Stroller – 3 wheeled jogging stroller with
 22 inch wheelbase
 Rolawheel – measures 13 inch width
 and 18 inch length
 ATV – collects grades and x-slopes
 based on the vehicle wheelbase
 OHV – same as ATV



Title of Slide Presentation



WISP Features

- One person operation to record grade and cross slope information
- Distance – forward/reverse
- Standard USB sensor box interface
- Laptop with Weather resistant touch screen recommended
- Extra battery suggested

WISP Hardware

- High speed sampling and adjustable digital filtering of grade and cross slope
- Dual reed switches to sense forward and backward movement



WISP Software Interface

- Designed for ETRACS compatibility
- Component Object Module (COM) interface to request distance, grade and cross slope
- Calibration routine provided
- Compatible with HETAP 2.0 software

High Efficiency Trail Assessment Process - HETAP Software 2.3

- Software that guides the user to collect objective surface and feature trail data
- Sort data to create grade, cross slope, surface and tread width reports
- SQL data base for compatibility with larger data base systems
- Calculation of Trail Access Information

Title of Slide Presentation

HETAP 2.3 Station Data

Automatic recording of grade, cross-slope and distance
Automatic capture of GPS position
Automatic image capture
Programmable alarms for grade and cross-slopes

HETAP 2.4 Feature Data

Feature type drop down lists
Provides for recording of rotational penetrometer firmness/stability
Image capture of features

HETAP 2.3 System Features

Data center to generate reports with sorting
Combine, reverse and split trail segments for data processing
Create TAI summary reports

Title of Slide Presentation

Computer Kiosk or Internet Site

TRAIL EXPLORER HOME ABOUT US DEFINITIONS LINKS TRAIL ACCESS INFORMATION

TRAIL FEATURES
Customize your search by trail use and features.

TRAIL ACCESS
Find a trail to suit your ability. Search by grade, cross-slope and surface.

TRAIL MANAGEMENT
Authorized trail managers may add or edit trail information. Contact Beneficial Designs.

QUICK TRAIL SEARCH
Type in (a few letters of) a park or trail name:

OR

View trails by state:
Choose a state:

PICK OF THE MONTH
My State: Indiana State Park
Boulder Creek, CA
Features: 2,000 year-old redwoods and over 40 miles of trails. Reservations required for camping. Phone: 831.328.5888

Have you ever finished a three hour hike in one hour? Have you struggled on a "moderate" trail? Have you encountered barriers on an "easy" trail? The Trail Explorer website is unique because it uses Trail Access Information to help trail users make informed decisions about which public lands to visit, and which trails will best meet their interests, abilities and desired experiences. Trail Explorer benefits all users, but is particularly helpful for individuals with disabilities, older adults, parents with young children, and novice hikers.

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links | acknowledgments | disclaimer
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TRAIL EXPLORER HOME ABOUT US DEFINITIONS LINKS TRAIL ACCESS INFORMATION

TRAIL FEATURES
Customize your search by trail use and features.

TRAIL ACCESS
Find a trail to suit your ability. Search by grade, cross-slope and surface.

TRAIL MANAGEMENT
Authorized trail managers may add or edit trail information. Contact Beneficial Designs.

CONTACT US

TRAIL ACCESS SEARCH Use this advanced search to find a trail to match your abilities by selecting your preferences from the options below. To broaden your search, remove preferences in categories of less importance. For the definition of a term, click on the term.

Choose a state:

Trail length: 1.0 mi (1.6 km) or less Surface Firmness: Firm or better

Typical grade: 5% or less Typical cross-slope: Less than 5%

Typical head width: No preference Minimum clearance width: 36 inches (91 cm) or greater

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www.trailexplorer.org

TRAIL EXPLORER HOME ABOUT US DEFINITIONS LINKS TRAIL ACCESS INFORMATION

TRAIL FEATURES
Customize your search by trail use and features.

TRAIL ACCESS
Find a trail to suit your ability. Search by grade, cross-slope and surface.

TRAIL MANAGEMENT
Authorized trail managers may add or edit trail information. Contact Beneficial Designs.

Choose a state: Indiana

Uses permitted: hiking/walking/running

Destination Feature: No preference

Desired trail length: 2.1 to 5.0 mi (3.3 to 8.0 km)

Typical grade: No preference

Firmness required: Firm or better

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www.trailexplorer.org

TRAIL EXPLORER HOME ABOUT US DEFINITIONS LINKS TRAIL ACCESS INFORMATION

9 trails found. Use the "back" button on your browser to refine your selection. Click on the trail name for more information. Click on the column heading to sort by column.

Trail	Park	State	Length	Typical Grade	Max Grade	Max Slope	Typical Trail Width	Min. Clear Width	Surface Firmness	Surface
Trail 10	McCormick's Creek State Park	IN	0.7 miles (1.1 km)	3.3%	34%	3.5%	50 in (126 cm)	na	Firm	Rock/Boulder
Trail 8	McCormick's Creek State Park	IN	0.7 miles (1.1 km)	2.3%	12%	1.1%	60 in (152 cm)	na	Paved	Asphalt
Trail A	McCormick's Creek State Park	IN	0.2 miles (0.3 km)	2.2%	9%	1.3%	58 in (146 cm)	na	Firm	Crushed Stone (Fines)
Trail 6	Spring Mill State Park	IN	0.4 miles (0.7 km)	2.3%	7%	2.2%	60 in (152 cm)	na	Paved	Asphalt
Trail 7	Spring Mill State Park	IN	0.9 miles (1.5 km)	3.3%	23%	3.1%	52 in (131 cm)	na	Firm	Soil
Trail 7 Spur to Trail A	Spring Mill State Park	IN	0.4 miles (0.6 km)	3.9%	27%	2.8%	49 in (125 cm)	na	Firm	Soil
Trail 10 Spur to Camels Back	Turkey Run State Park	IN	0.1 miles (0.2 km)	0.9%	2%	1.8%	60 in (152 cm)	na	Firm	Crushed Stone (Fines)
Trail 11	Turkey Run State Park	IN	0.2 miles (0.3 km)	3.1%	9%	4.3%	60 in (152 cm)	na	Firm	Crushed Stone (Fines)
Trail 7 Spur to Lemonland	Turkey Run State Park	IN	0.1 miles (0.2 km)	3.3%	6%	2.7%	60 in (152 cm)	na	Firm	Soil

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TRAIL EXPLORER HOME ABOUT US DEFINITIONS LINKS TRAIL ACCESS INFORMATION

Trail 11
Turkey Run State Park
Route 1, Box 164
Marshall, IN 47659
County:

Phone: (765) 597-2635
FAX:
Email:

Website: <http://www.state.in.us/go/park/park/park/turkeyrun.html>

Length: 0.2 miles (0.3 km)

Destination: Lieber Memorial & Log Church
Destination Type: Historical

Trail 11 starts from the Service Road besides the Turkey Run Inn. A short hike about Turkey Run Hollow to the Lieber Memorial and Log Church.

Cumulative Elevation Gain: 23 ft (7 m)
Cumulative Elevation Loss: 4 ft (1 m)

Uses: Hiking

Facilities: Historical

Features: Lieber Memorial Log Church

Obstructions:

Typical Grade is 3.1%
7% of the trail is 0% to 5%
64 ft (20 m) is 0% to 5%
0% grade is a standard ramp.

Minimum Tread Width is 60 in (152 cm)
Maximum Tread Width is 60 in (152 cm)

Typical Cross Slope is 4.3%
10% of the trail is 0% to 11%
180 ft (49 m) is 10% to 11%

Trail Surface is Crushed Stone (Fines)
50% of the trail is Firm
0 ft (0 m) of the trail is Soft

TRAIL EXPLORER HOME ABOUT US DEFINITIONS LINKS TRAIL ACCESS INFORMATION

Trail 11
Turkey Run State Park
Route 1, Box 164
Marshall, IN 47659
County:

Phone: (765) 597-2635
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TAI Information Sheet

TRAIL EXPLORER HOME ABOUT US DEFINITIONS LINKS TRAIL ACCESS INFORMATION

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Turkey Run State Park
Route 1, Box 164
Marshall, IN 47659
County:

Phone: (765) 597-2635
FAX:
Email:

Website: <http://www.state.in.us/go/park/park/park/turkeyrun.html>

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Obstructions:

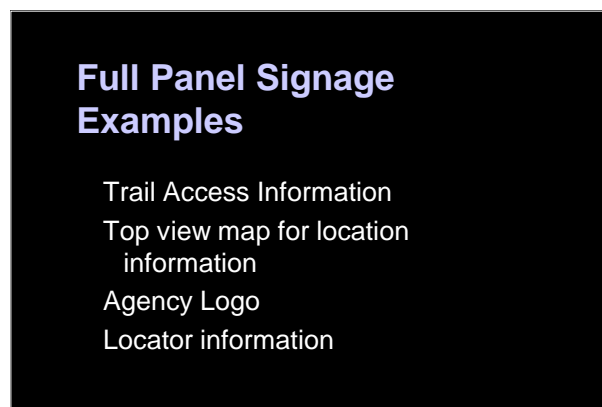
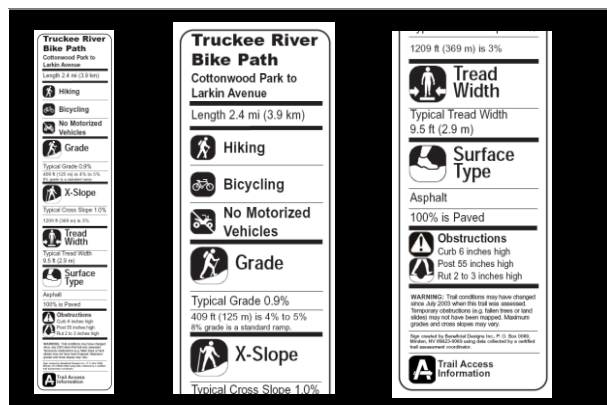
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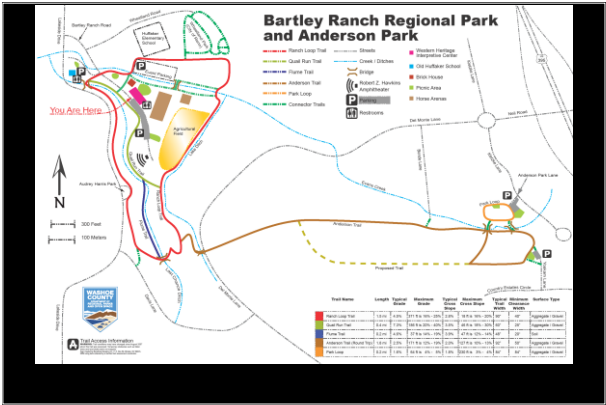
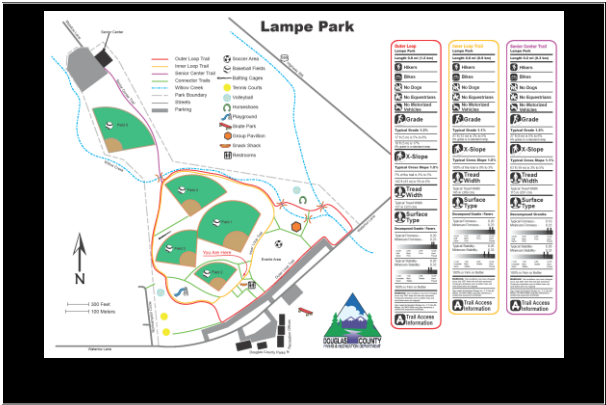
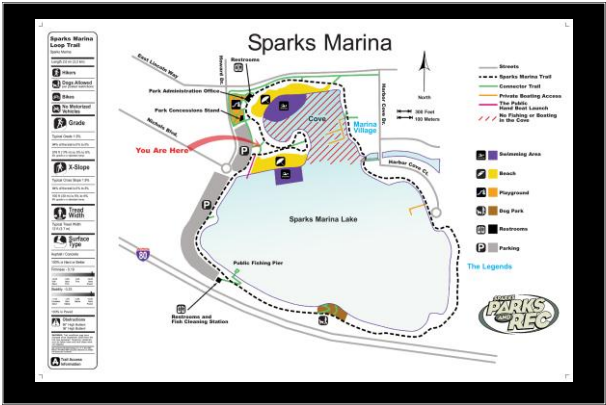
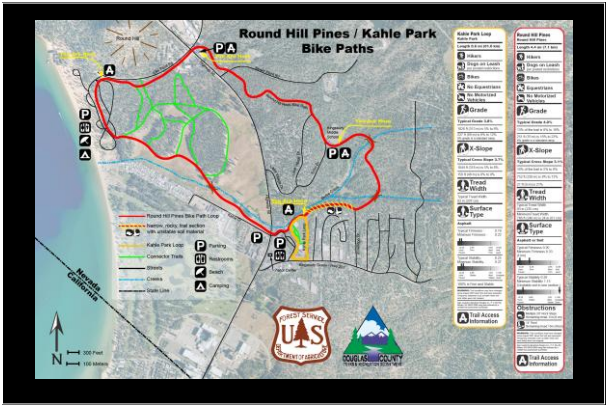
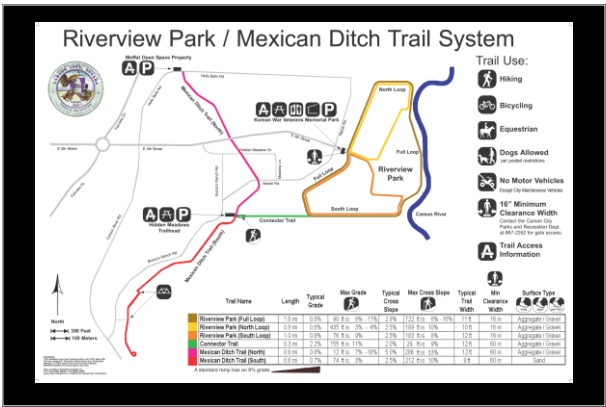
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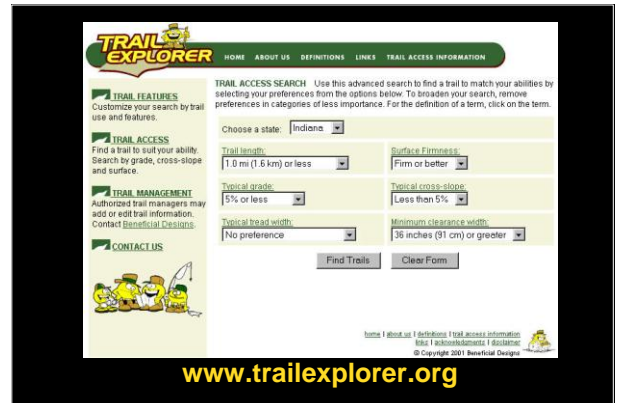
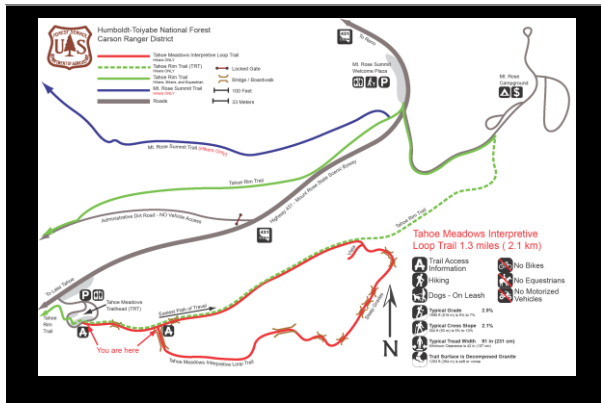
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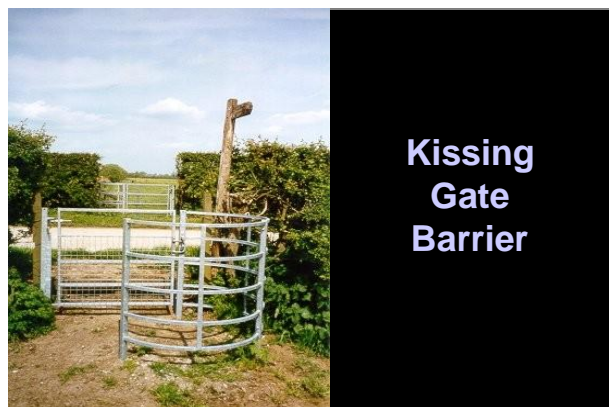
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K Barrier

Beneficial Designs Trail Gate Barrier Work



First Inverted Bollard Design

Motorcycle Testing



Second Inverted Bollard Design

Abilities EXPO



Third Inverted Bollard Design

Motorcycle Testing



Title of Slide Presentation

Electronic Trail Gate Barrier

- Detect the presence of motorized trail vehicle at trail access entry
- Notify via phone or internet message
- Voice, image, text or GSM text message
- Report via alarm or dispatch service
- Capture of video before and after event
- Onsite alarm options



Pedestrian and Motorized Vehicle Trail Traffic Counter



Electronic TGB Specifications

- Infra-red sensor technology with fresnel lens
- Field of view is approx 2 degrees
- At 50 feet the field of view is approx 20 inches
- Dynamic detection of hot objects entering field of view

Electronic Trail Gate Barrier

- Set up 32 inch clearance mechanical trail gate barrier with steel or concrete bollards
- Detect the presence of motorized trail vehicle at trail access entry point
- Silently report violation using desired format or onsite alarm

Public Rights of Way Assessment Process (PROW-AP)

Peter Axelson, Barton Cline,
Dana Helwig, Nathan Tolbert

Beneficial Designs, Inc.
Minden, Nevada

Title of Slide Presentation

Reasons for Assessment of Sidewalks

- Assess existing conditions
- Determine compliance with guidelines
- Identify obstructions and hazards
- Prioritize reconstruction

Users of Detailed Sidewalk Data

- Sidewalk Planners
- Designers
- Engineers
- Contractors
- Inspectors

SWAP

Data collection along sidewalk segments

- Element Data
- Curb Ramps
- Driveway Crossings
- Medians
- Pork-chops etc.



Curb Ramp Data Collection Form

Date: _____ Date Recorder: _____

CURB RAMP LOCATION

Street Name: _____ Side of Street: N S W E
 Nearest Corner (Sketch): _____ Indicate Corner of Intersection: N S W E
 GPS Coordinates: N/S E/W Adjusted Property Description: _____

CURB RAMP CHARACTERISTICS/SIDEWALK ELEMENTS

Include all sidewalk elements (e.g. utility poles, signs, etc.) on the drawing to indicate their position.

Digital Image taken—frame # and description: _____

Record any surface height transitions over 0.25 inches using a profile gauge.

Draw the transition on the back of the form. Then indicate the location on drawing.

Curb Ramp Type: ☐ Diagonal ☐ Parallel ☐ Perpendicular ☐ Other _____

Surface Material Type: ☐ Asphalt ☐ Concrete ☐ Cobblestone ☐ Other _____

Recommended Action: ☐ Repair ☐ Reconstruct ☐ Monitor ☐ Other _____

Title of Slide Presentation

Driveway Data Collection Form

Date: _____ Recorder: _____

DRIVEWAY LOCATION

Street Name: _____ Date of Street: N S W E

Nearest Cross Street: _____

Lot: _____

Coordinates: N/S S/W Adjacent Property Description: _____

Diagram showing driveway layout with dimensions and slopes.

DRIVEWAY CHARACTERISTICS/SIDWALK ELEMENTS

Include all sidewalk elements (i.e. utility poles, signs, etc.) on the drawing to indicate their position.

Right image taken: _____ from _____ and description: _____

Record any surface height transitions over 0.25 inches using a profile gauge. Take the transition on the back of this form. Then indicate the location on drawing.

Driveway Type: ☐ Offset Sidewalk ☐ Asphalt ☐ Paved ☐ Concrete ☐ Other _____

Surface Material Type: ☐ Concrete ☐ Asphalt ☐ Paved ☐ Other _____

Recommended Action: ☐ Repair ☐ Construct ☐ Remove ☐ Monitor ☐ Other _____

SWAP

Tedious

Time Consuming

Bending and squatting – 10-20x per sidewalk element and on sidewalk segments



HEIGHT TRANSITIONS Project #: 216-2 Date: 4/27/09

Street Name: OLIVER ST Segment Name: * Distance: 235' 9"

* N COUNTY ROAD TO HICKLAND

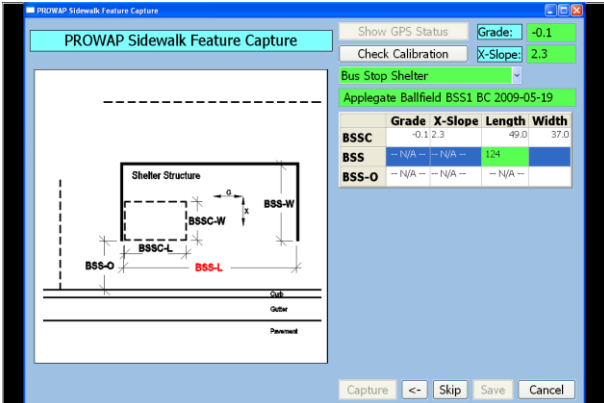
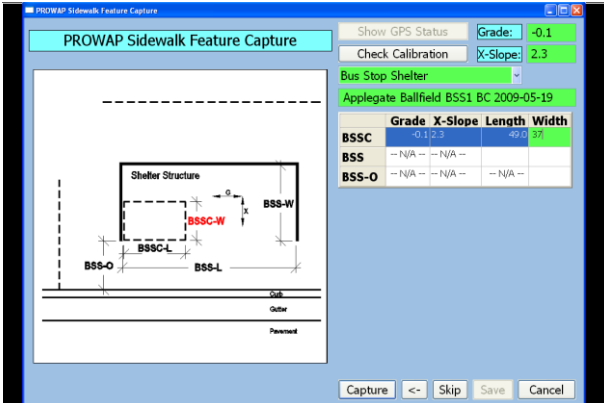
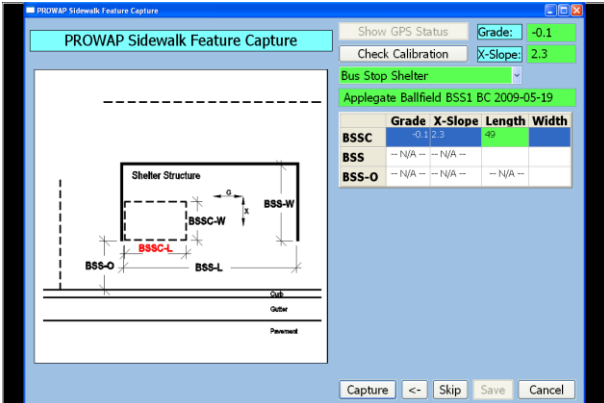
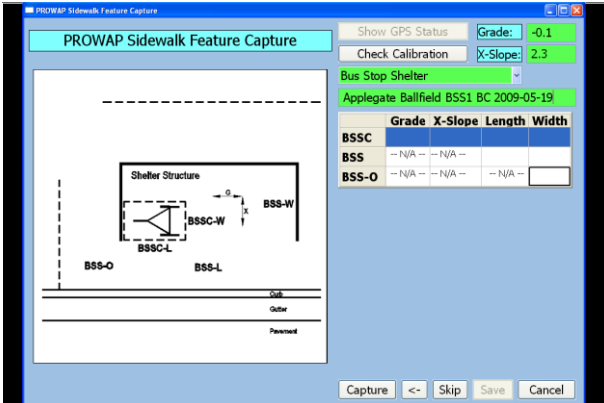
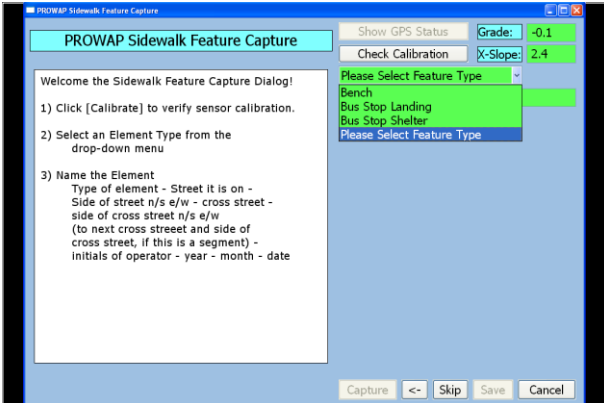
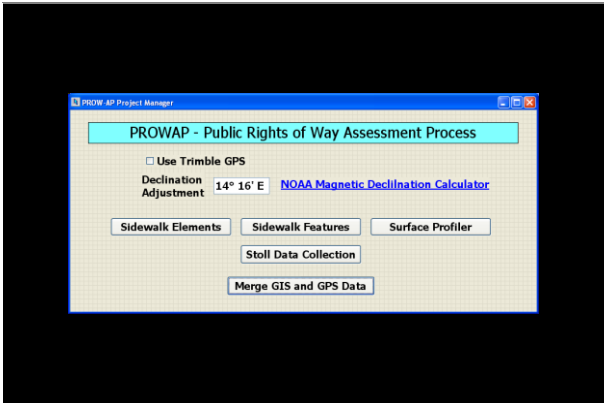
Diagram showing a cross-section of a sidewalk with a height transition. The transition is marked with a vertical line. The height difference is indicated as 9/16" and 0.56.

Manual Data Collection Error Potential

- Smart level in wrong units
- Smart level on hold
- Misreading of smart level
- Data recording errors
- Data entry error



Title of Slide Presentation



Title of Slide Presentation

PROWAP Sidewalk Feature Capture

Show GPS Status **Grade: -0.1**

Check Calibration **X-Slope: 2.3**

Bus Stop Shelter

Applegate Ballfield BSS1 BC 2009-05-19

Grade	X-Slope	Length	Width
BSSC	-0.1 2.3	49.0	37.0
BSS	-- N/A --	-- N/A --	124.0 56.0
BSS-O	-- N/A --	-- N/A --	-- N/A -- 4.2

Diagram showing a bus stop shelter structure with labels: Shelter Structure, BSSC-W, BSS-L, BSS-O, BSS-W, BSS-L, Sub, Outer, Pavement.

Capture <- Skip Save Cancel

PROWAP Sidewalk Feature Capture

Show GPS Status **Grade: 0.7**

Check Calibration **X-Slope: 2.4**

Bus Stop Landing

Applegate Ballfield BSL1 BC 2009-05-19

Grade	X-Slope	Length	Width
BSL			
DAL		-- N/A --	-- N/A --
DAR		-- N/A --	-- N/A --

Diagram showing a bus stop landing structure with labels: BSL-L, BSL-W, DAL-L, BSL, DAL-R, Sub, Outer, Pavement.

Capture <- Skip Save Cancel

PROWAP Sidewalk Feature Capture

Show GPS Status **Grade: 0.7**

Check Calibration **X-Slope: 2.4**

Bench

Applegate Ballfield BN1 BC 2009-05-19

Grade	X-Slope	Length	Width
BN			
BN-H	-- N/A --	-- N/A --	-- N/A --

Diagram showing a bench structure with labels: BN-H, BN-W, Bench, BN-L, OR, Sub, Outer, Pavement.

Capture <- Skip Save Cancel

PROWAP Sidewalk Feature Capture

Show GPS Status **Grade: 0.7**

Check Calibration **X-Slope: 2.4**

Bench

Applegate Ballfield BN1 BC 2009-05-19

Grade	X-Slope	Length	Width
BN	0.7 2.4	49	
BN-H	-- N/A --	-- N/A --	-- N/A --

Diagram showing a bench structure with labels: BN-H, BN-W, Bench, BN-L, OR, Sub, Outer, Pavement.

Capture <- Skip Save Cancel

PROWAP Sidewalk Feature Capture

Show GPS Status **Grade: 0.7**

Check Calibration **X-Slope: 2.4**

Bench

Applegate Ballfield BN1 BC 2009-05-19

Grade	X-Slope	Length	Width
BN	0.7 2.4	49.0	37
BN-H	-- N/A --	-- N/A --	-- N/A --

Diagram showing a bench structure with labels: BN-H, BN-W, Bench, BN-L, OR, Sub, Outer, Pavement.

Capture <- Skip Save Cancel

PROWAP Sidewalk Feature Capture

Show GPS Status **Grade: 0.6**

Check Calibration **X-Slope: 2.4**

Bench

Applegate Ballfield BN1 BC 2009-05-19

Grade	X-Slope	Length	Width
BN	0.7 2.4	49.0	37.0
BN-H	-- N/A --	-- N/A --	28 -- N/A --

Diagram showing a bench structure with labels: BN-H, BN-W, Bench, BN-L, OR, Sub, Outer, Pavement.

Capture <- Skip Save Cancel

Title of Slide Presentation

PROWAP Sidewalk Element Capture

Welcome the Sidewalk Element Capture Dialog!

- 1) Click [Calibrate] to verify sensor calibration.
- 2) Select an Element Type from the drop-down menu
- 3) Name the Element
Type of element - Street it is on -
Side of street n/s e/w - cross street -
side of cross street n/s e/w
(to next cross street and side of
cross street, if this is a segment) -
initials of operator - year - month - date

Garmin GPS Status:
Error: Garmin GPS is not connected

Buttons: Show GPS Status, Grade: off-line, Check Calibration, X-Slope: off-line, Please Select Element Type, Diagonal Curb Ramp, Perpendicular Crossing, Please Select Element Type, Capture, <, Skip, Save, Cancel

Data Export

SQL data structure
Trimble Pathfinder Office
Into GIS Software
Into CAD Software
Excel

Station Capture - PROW AP: Public Works: Main

Last Station Recorded: [Empty]

Copy Surf. Data -> [Empty]

Current Station To Record: [Empty]

Record Station: [Empty]

Tread Width: 48 in Set MCW [Empty]

Surface Category: Paved

Surface Type: Concrete

Distance: [Empty] Distance Measurement is on hold.

Grade: 12.2

Cross Slope: 3.7

Buttons: Alarm Settings, Calibration, New Segment, View Data, Distance Hold, Manual Entry, Return Home

Current Segment: CC PW Main 1st to 2nd 2009-05-1

Compass Heading: ° True

GPS Location and Status

Lat: [Empty]

Lon: [Empty]

Apprx. Err: [Empty]

Elev: [Empty]

Vehicle Orientation: Forwards, Backwards

Show Camera Preview [Empty]

Error: Garmin GPS is not connected

Station Capture - PROW AP: Public Works: Main

Last Station Recorded: 48 in

Copy Surf. Data -> [Empty]

Current Station To Record: [Empty]

Record Station: [Empty]

Tread Width: 48 in Set MCW [Empty]

Surface Category: Paved

Surface Type: Concrete

Distance: 10.3 Ft

Grade: 0.0 %

Cross Slope: -0.0 %

Buttons: Alarm Settings, Calibration, New Segment, View Data, Distance Hold, Manual Entry, Return Home

Current Segment: CC PW Main 1st to 2nd 2009-05-1

Compass Heading: ° True

GPS Location and Status

Lat: [Empty]

Lon: [Empty]

Apprx. Err: [Empty]

Elev: [Empty]

Vehicle Orientation: Forwards, Backwards

Show Camera Preview [Empty]

Error: Garmin GPS is not connected

Sidewalk Access Summary Info

Carson City
Washington St
Wash. N Roop to Valley JV 2009-04-21

Assessment Date:

Agency: Public Works
State: Nevada
County: [Empty]

Trail Length: 0.1 mi (0.2 km) Trail Type: [Empty]
Elevation Gain: 6.3 ft (1.9 m)
Loss: 2.7 ft (0.8 m)

Typical Grade: 1.2% Maximum Grade: 8.5%
Typical Cross Slope: 4.2% Maximum Cross Slope: 17.0%
Typical Tread Width: 48.0 in (121 cm) Minimum Tread Width: 30.0 in (76 cm)

Sidewalk Segment Station Data for 33 Maximum Grades

Report Type: New Grade

Report Date: 2009-04-21

Seq. Number	Station Location	Station Length	Grade Length	Grade Percent	Tread Width	X-Slope Width	Grade (%)	Surface Category	Surface Type	Lat	Lon
2	179 780.0	1.5	1.5	3.2	48.0	-5.4	-6.5	Paved	Concrete	39.28579	-125.76204
2	179 780.0	1.5	1.5	3.2	48.0	-5.4	-6.5	Paved	Concrete	39.28587	-125.76207
3	179 782.0	1.5	1.5	3.2	48.0	-5.4	-6.5	Paved	Concrete	39.28595	-125.76211
4	179 782.0	1.5	1.5	3.2	48.0	-5.4	-6.5	Paved	Concrete	39.28603	-125.76215
5	179 782.0	1.5	1.5	3.2	48.0	-5.4	-6.5	Paved	Concrete	39.28611	-125.76219
6	179 782.0	1.5	1.5	3.2	48.0	-5.4	-6.5	Paved	Concrete	39.28619	-125.76223
7	179 782.0	1.5	1.5	3.2	48.0	-5.4	-6.5	Paved	Concrete	39.28627	-125.76227
8	179 782.0	1.5	1.5	3.2	48.0	-5.4	-6.5	Paved	Concrete	39.28635	-125.76231
9	179 782.0	1.5	1.5	3.2	48.0	-5.4	-6.5	Paved	Concrete	39.28643	-125.76235
10	179 782.0	1.5	1.5	3.2	48.0	-5.4	-6.5	Paved	Concrete	39.28651	-125.76239
11	179 782.0	1.5	1.5	3.2	48.0	-5.4	-6.5	Paved	Concrete	39.28659	-125.76243
12	179 782.0	1.5	1.5	3.2	48.0	-5.4	-6.5	Paved	Concrete	39.28667	-125.76247
13	179 782.0	1.5	1.5	3.2	48.0	-5.4	-6.5	Paved	Concrete	39.28675	-125.76251
14	179 782.0	1.5	1.5	3.2	48.0	-5.4	-6.5	Paved	Concrete	39.28683	-125.76255
15	179 782.0	1.5	1.5	3.2	48.0	-5.4	-6.5	Paved	Concrete	39.28691	-125.76259
16	179 782.0	1.5	1.5	3.2	48.0	-5.4	-6.5	Paved	Concrete	39.28699	-125.76263
17	179 782.0	1.5	1.5	3.2	48.0	-5.4	-6.5	Paved	Concrete	39.28707	-125.76267
18	179 782.0	1.5	1.5	3.2	48.0	-5.4	-6.5	Paved	Concrete	39.28715	-125.76271
19	179 782.0	1.5	1.5	3.2	48.0	-5.4	-6.5	Paved	Concrete	39.28723	-125.76275
20	179 782.0	1.5	1.5	3.2	48.0	-5.4	-6.5	Paved	Concrete	39.28731	-125.76279
21	179 782.0	1.5	1.5	3.2	48.0	-5.4	-6.5	Paved	Concrete	39.28739	-125.76283
22	179 782.0	1.5	1.5	3.2	48.0	-5.4	-6.5	Paved	Concrete	39.28747	-125.76287
23	179 782.0	1.5	1.5	3.2	48.0	-5.4	-6.5	Paved	Concrete	39.28755	-125.76291
24	179 782.0	1.5	1.5	3.2	48.0	-5.4	-6.5	Paved	Concrete	39.28763	-125.76295
25	179 782.0	1.5	1.5	3.2	48.0	-5.4	-6.5	Paved	Concrete	39.28771	-125.76299
26	179 782.0	1.5	1.5	3.2	48.0	-5.4	-6.5	Paved	Concrete	39.28779	-125.76303
27	179 782.0	1.5	1.5	3.2	48.0	-5.4	-6.5	Paved	Concrete	39.28787	-125.76307
28	179 782.0	1.5	1.5	3.2	48.0	-5.4	-6.5	Paved	Concrete	39.28795	-125.76311
29	179 782.0	1.5	1.5	3.2	48.0	-5.4	-6.5	Paved	Concrete	39.28803	-125.76315
30	179 782.0	1.5	1.5	3.2	48.0	-5.4	-6.5	Paved	Concrete	39.28811	-125.76319
31	179 782.0	1.5	1.5	3.2	48.0	-5.4	-6.5	Paved	Concrete	39.28819	-125.76323
32	179 782.0	1.5	1.5	3.2	48.0	-5.4	-6.5	Paved	Concrete	39.28827	-125.76327
33	179 782.0	1.5	1.5	3.2	48.0	-5.4	-6.5	Paved	Concrete	39.28835	-125.76331

Title of Slide Presentation

Repeatability Segment Testing

Typical grades and cross slopes were within 0.5%

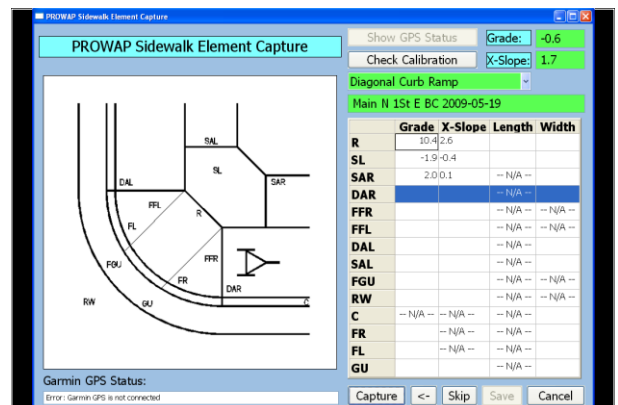
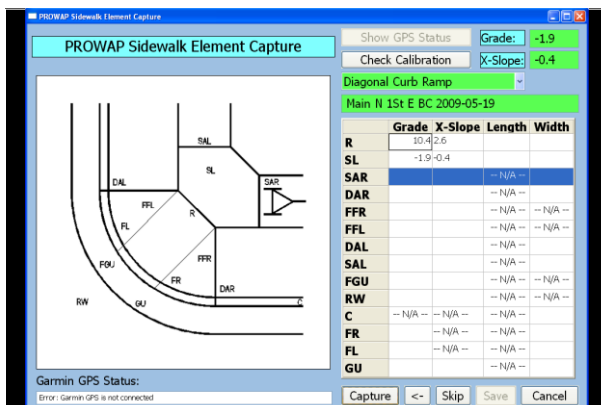
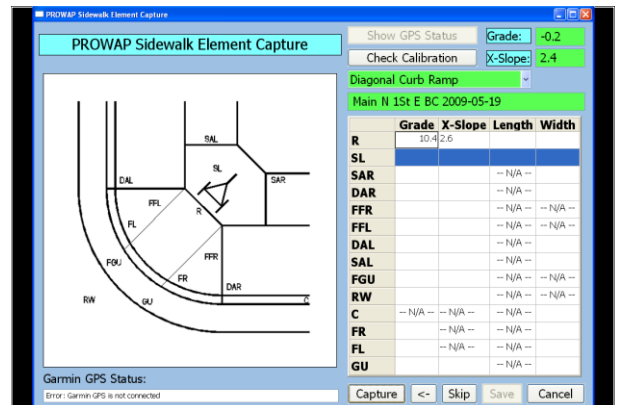
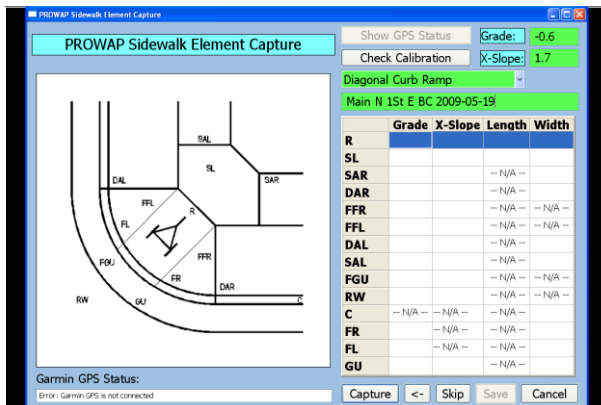
Maximum grades and cross slopes were within 2.0%

Time Study of Sidewalk Element Measurement

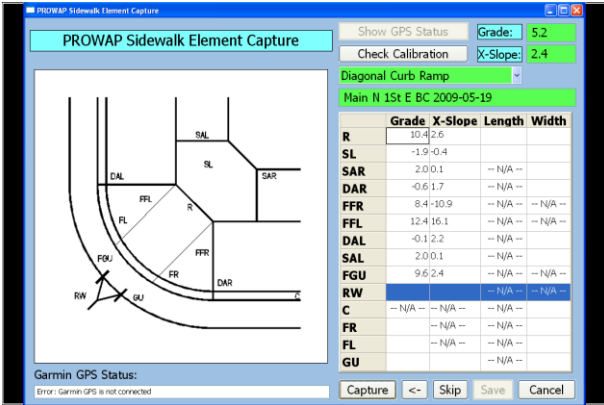
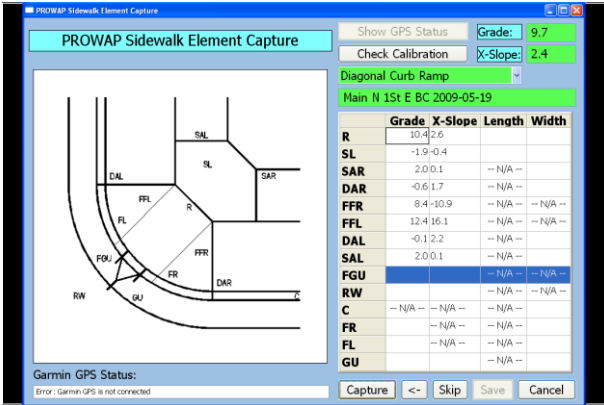
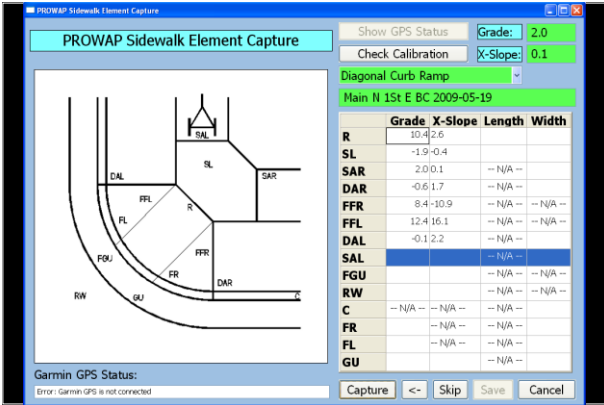
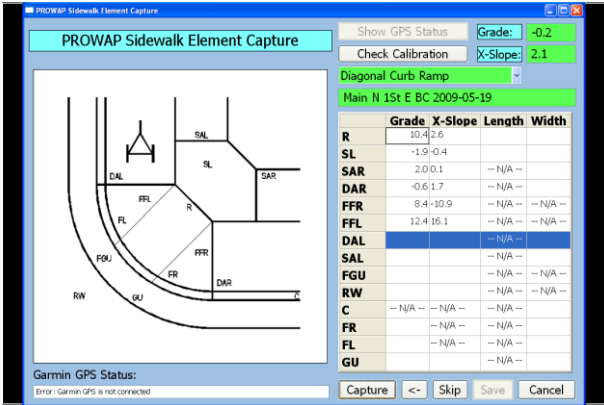
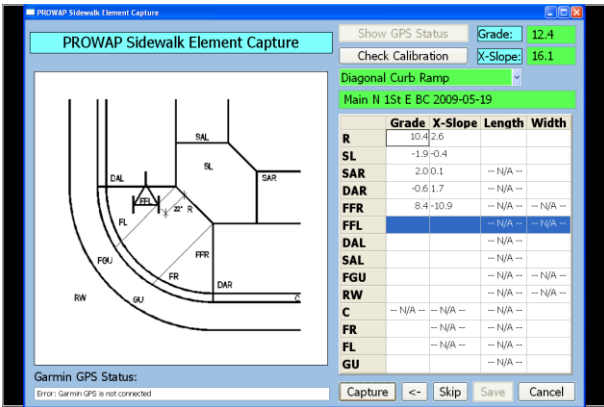
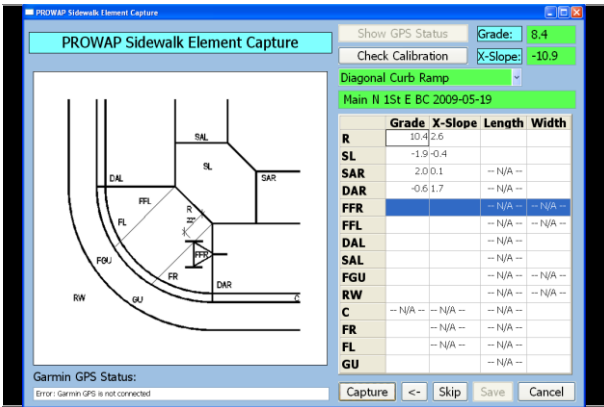
5 Curb Ramps and 5 Driveway crossings measured with SWAP and PROW-AP

Measured by 5 different assessment coordinators without experience

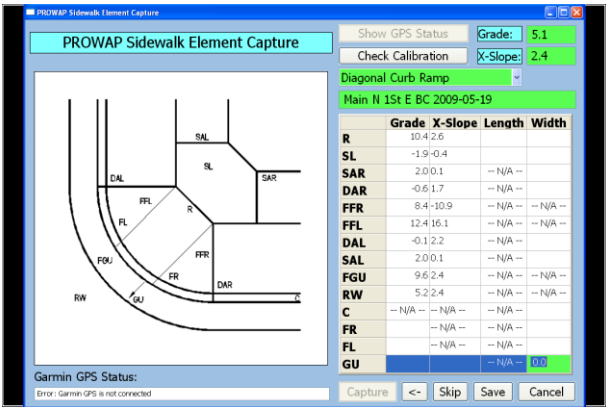
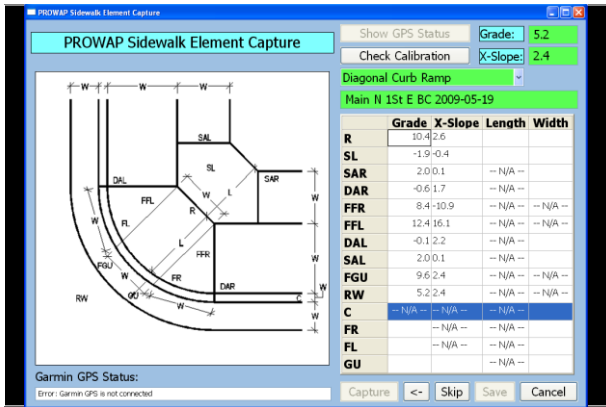
75 - 80% time savings noted



Title of Slide Presentation

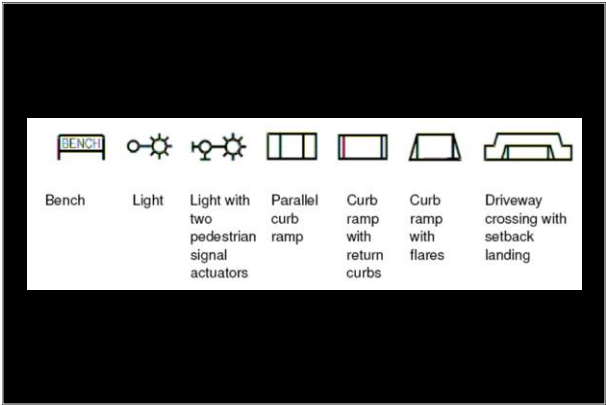
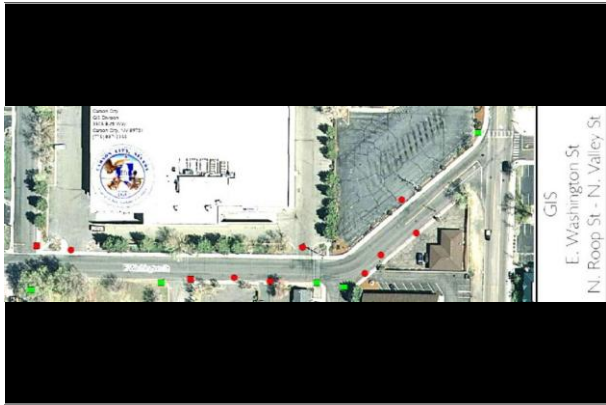
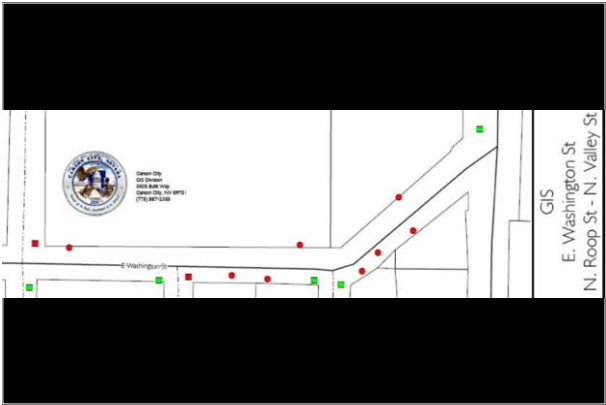


Title of Slide Presentation



Designing for GIS Compatibility

Points – Features – Elements
Lines – Sidewalk corridors
Sidewalk symbol font library



Title of Slide Presentation

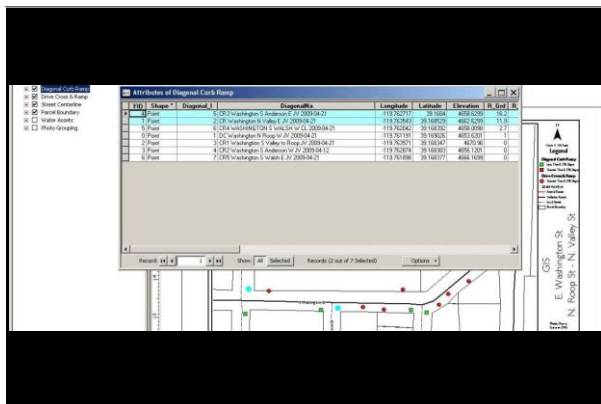
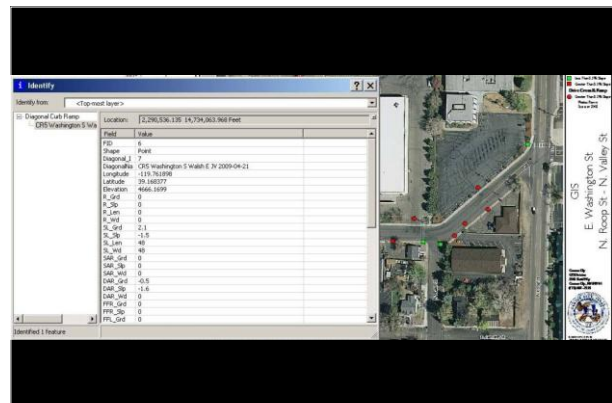
Creation of Shape Files

Use CAD software to process data

- AutoCAD Map
- Microstation

Or bring data into GIS software using scripts written for the data

- ArcMap with ArcInfo



PROW-AP Municipality Benefits

- Prevention of liability
- Reduction in complaints
- Reduce need to reconstruct

PROW-AP Benefits

- 75-80% less personal time required
- Automatic data recording
- Less physical stress and fatigue
- No hard paper copies
- Increased data accuracy

Acknowledgement

Phase I SBIR funding for the High Efficiency Pedestrian Sidewalk Assessment Process was provided by the U.S. Department of Transportation through Federal Highways Administration grant number DTRT57-08-C-10058.

Title of Slide Presentation

Improving Trail Surfaces

- Provide firm and stable surfaces
- Remove trail obstructions
- Protect environmental and cultural resources



Tahoe Meadows Interpretive Trail Accessibility Improvements



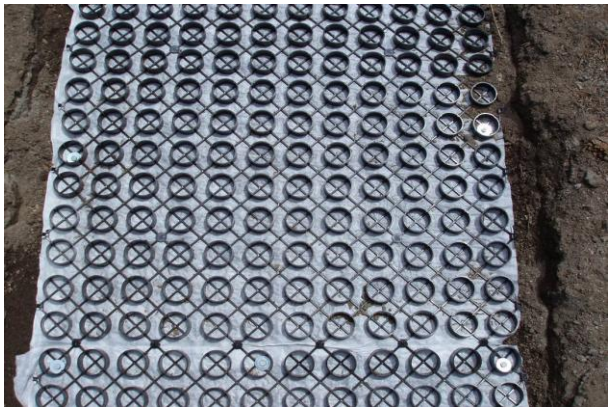
Title of Slide Presentation



Title of Slide Presentation



Title of Slide Presentation



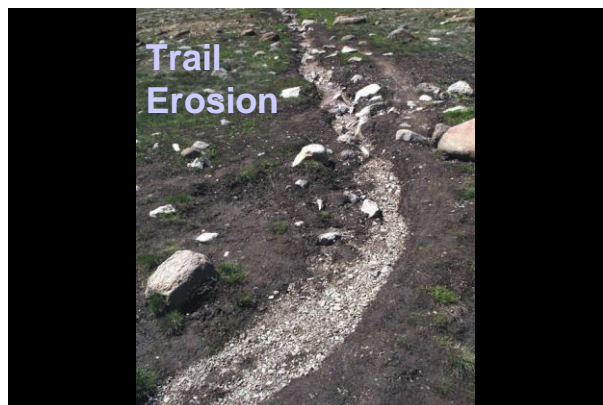
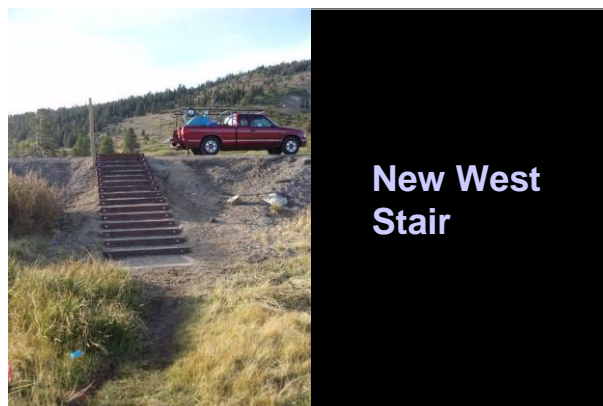
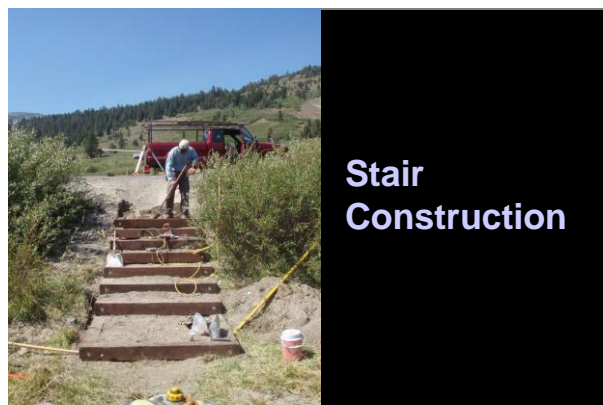
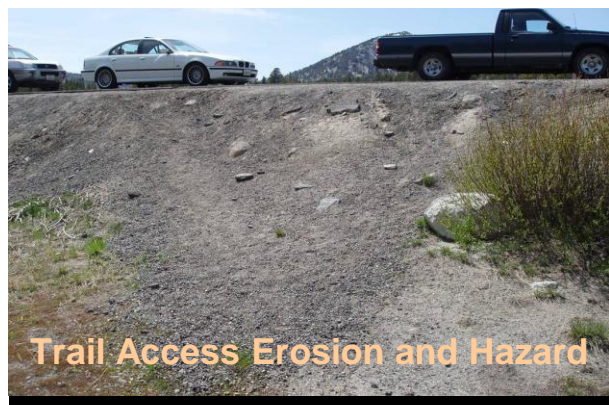
Title of Slide Presentation

Rotational Penetrometer Readings-Gravelpave 2

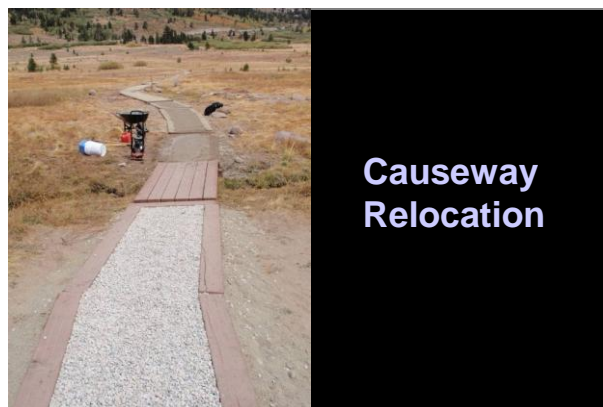
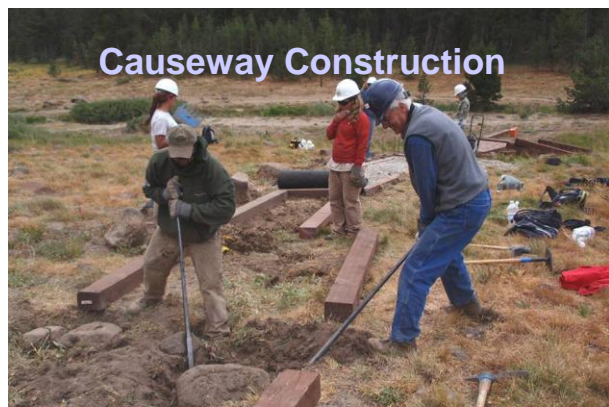
<i>Before</i> Application		<i>After</i> Application	
Firmness	Stability	Firmness	Stability
0.18	0.77	0.17	0.37
0.17	0.87	0.17	0.38
0.17	0.77	0.18	0.42
0.18	0.88	0.17	0.35
0.18	0.79	0.18	0.40
0.18	Avg 0.82	0.17	Avg 0.38



Title of Slide Presentation



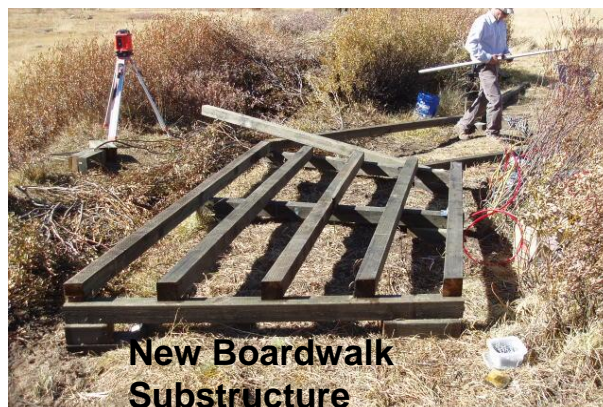
Title of Slide Presentation



Title of Slide Presentation



**Existing
Experimental
Boardwalk**



**New Boardwalk
Substructure**



**Trex & Plastic
Surface**



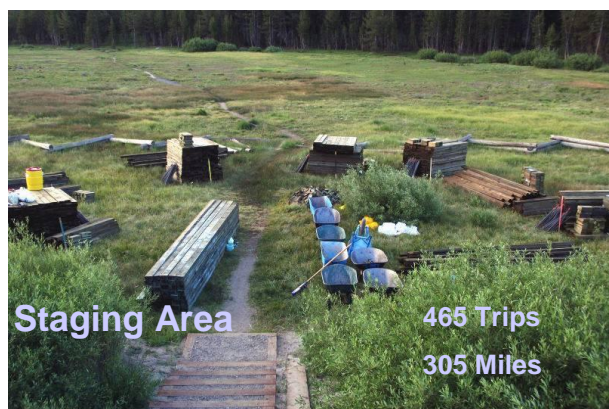
Side View

Material Handling Issues



This won't be too hard...

Title of Slide Presentation



Title of Slide Presentation



West End



Side Ramp to Creek



1/4 Mile Long



Wet Bog in
Late Spring

Happy
grasses



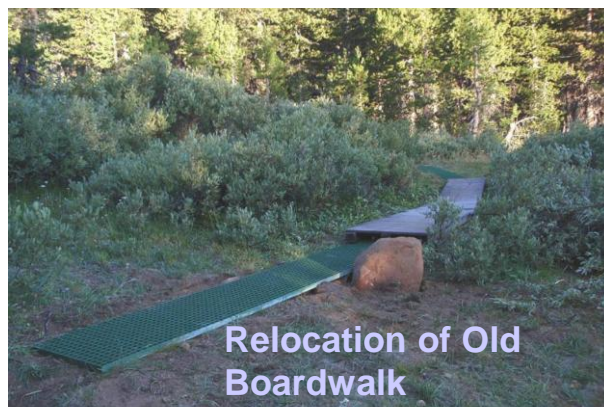
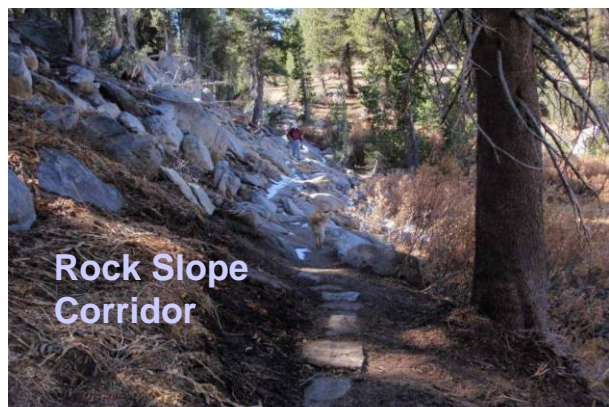
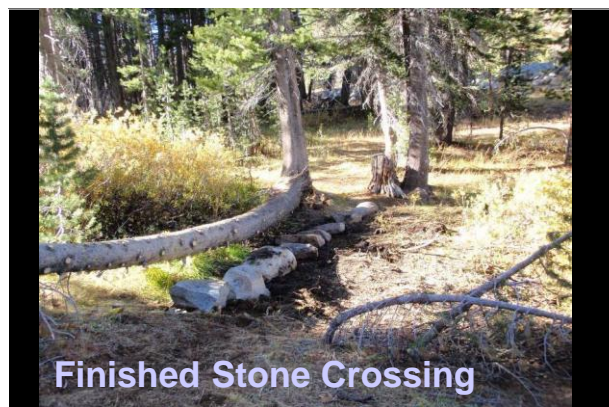
Foot Trail Construction



Corridor Clearing

Pionjar Rock Drilling

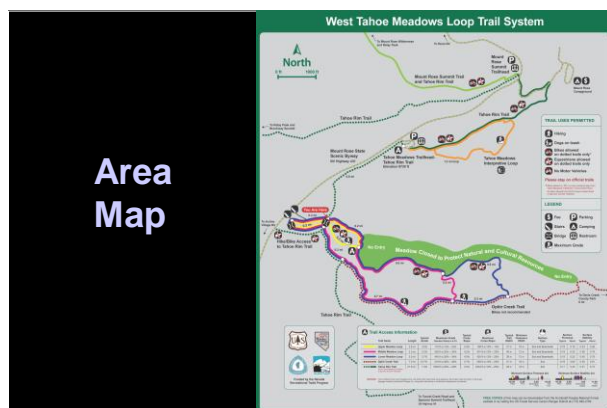
Title of Slide Presentation



Title of Slide Presentation



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Funding Support

Nevada Recreational Trails Program-
Nevada Division of State Parks

Administered by the Federal
Highway Administration (FHWA)
Safe, Accountable, Flexible, Efficient
Transportation Equity Act: A
Legacy for Users (SAFETEA-LU)

Beneficial Designs, Inc.

Minden, Nevada

www.beneficialdesigns.com
mail@beneficialdesigns.com
775.783.8822 voice
775.783.8823 fax

*Working toward universal access
through research, design & education*

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Beneficial Designs, Inc.
Minden, Nevada
www.beneficialdesigns.com
peter@beneficialdesigns.com
jeremy@beneficialdesigns.com
775.783.8822 voice
775.783.8823 fax

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Minden, Nevada
www.beneficialdesigns.com
mail@beneficialdesigns.com
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